

## Accelerator Systems Division Highlights Ending January 30, 2004

### ASD/LANL: Warm Linac

#### HIGH-POWER RF (WBS 1.4.1.1)

Accomplishments This Week: (1) LANL conditioned two 2.5-MW windows for the CCL. (2) LANL approved CPI factory acceptance data for SC Linac klystron S/N 47, and authorized shipment to ORNL. (3) K. Young and D. Rees were at the SNS site to support first 5-MW CCL klystron tests, and waveguide installation QA.

Concerns & Actions: We continue to have daily contact with the president of MCI, the manufacturer of the defective SC linac flexible waveguide. MCI is applying the reflective and the absorptive coatings on separate flex sections. They plan to be present at LANL next week when we test them at full reflected power conditions (2.2 MW). MCI's first attempt at the braze solution failed. They are retrying with new tooling this week. Meanwhile, LANL and ORNL are developing a backup plan should all three MCI repair options fail. That backup would involve reducing the number of flex sections in the SCL and replacing them with straight sections provided by MCI as part of the warranty. That would enable the Project to more economically use the good flex sections already on hand from the other supplier (Mega), thereby reducing the required replacement pieces we would need to procure if we were to default MCI.

#### HIGH-VOLTAGE CONVETER MODULATOR (HVCM) (WBS 1.4.1.2)

Accomplishments: (1) The production HVCM at LANL was brought back on line on 1/23/04. It operated satisfactorily all week to support the CCL window conditioning with the 5-MW klystron. (2) D. Anderson was at LANL to discuss operations, modeling, and contract novation to ORNL.

Concerns & Actions: LANL communicated to ORNL advice on the start pulse configuration for SCL-ME1 HVCM. This configuration should reduce IGBT back-diode oscillations, reducing IGBT start pulse current, and for the SCL, improving the HVCM output pulse fidelity for the first 0.1 ms.

#### DRIFT-TUBE LINAC (WBS 1.4.2)

Accomplishments: (1) LANL received drift tube 2-02 from ORNL. CMI did machine prep, LANL cleaned and leak checked, and shipped it to GAR for electroforming. (2) LANL received final dimensions from ORNL for the tank-2 tuners. Slug tuners were completed and shipped to ORNL. Post couplers were machined and will be e-beam welded at ESCO next week. P. Smith and P. Gibson will be at ESCO to supervise. (3) Drift tube 6-17 was partially electroformed at GAR (copper coating thickness at  $\sim 0.02''$ , which is  $\sim 50\%$  of spec), and shipped to ORNL for leak checking.

Issues and Concerns: (1) The bore of drift tube 2-02 was found to be damaged from mechanical abuse. Inspection report was quantified and communicated to ORNL. Damage should not degrade RF performance; however, we recommend that ORNL remap the mechanical coordinates and the magnet performance.

#### COUPLED CAVITY LINAC (WBS 1.4.4)

Accomplishments: G. Johnson and N. Bultman are at ACCEL to supervise CCL cavity manufacturing and testing, and to discuss contract closeout. Despite setbacks in vacuum seals and vacuum brazing (see below), ACCEL still forecasts final shipment (Module-4) on 4/8/04.

Concerns & Actions: ACCEL incurred two setbacks this week: (1) Module-2 bridge coupler - segment seals continue to leak after repair. Leaks are relatively large ( $1\text{E-}6$  to  $1\text{E-}7$  Torr-l/s). We speculate that the problem is sealing surface preparation. More careful polishing of surfaces reduced the leaks to the  $1\text{E-}8$  scale so further work is needed to meet the specification of  $< 1.0\text{E-}8$  Torr-l/s. ACCEL decided to delay shipment of CCL Module-2 for at least one week (to 2/13/04) to allow time to correct the leak problems. We agree with this decision. We do not believe that this delay will significantly impact CCL installation plans. Given the extra attention for vacuum preparation and inspection, we are exploring options to reverse the sequence for vacuum tests and tuning on Modules 3 and 4. This will provide additional schedule float for vacuum work, plus eliminate extra handling steps. (2) We lost 3 days in Module-3 manufacturing due to a failure of an ACCEL vacuum furnace pump. The Module-3 segment and braze foils located in the furnace during the failure were not damaged. ACCEL installed a spare pump and restarted brazing on 1/29. They will work through the weekend to recover schedule. ACCEL still forecasts final shipment (Module-4) on 4/8/04.

**PROJECT MANAGEMENT (WBS 1.4.5)**

Los Alamos SNS Division will disband in 63 days. We are working with SNS-ORNL on closeout issues. Contract novation for the HVCN subsystems and CCL cavities contract are being completed. PCR LI 02 008 was approved transferring LANL budget to ORNL to support a pending engineering change notice for the CCL cavities. HEBT drawings were completed and shipped to ORNL, as were DTL travelers, and CCL native files.

**ASD/JLAB: Cold Linac****JLab SNS Cryomodule Production Status Report**

For Period Ending January 30, 2004

|                         | Cum. To Date |        | Previous 4 Wk<br>Running Average |        | Next 4 Wk Rate (To<br>Complete by Jan. 05) |
|-------------------------|--------------|--------|----------------------------------|--------|--|
|                         | Plan         | Actual | Plan                             | Actual |  |
| Cavities<br>Produced    | 35           | 37     | 3                                | 1      | 4  |
|                         |              |        |                                  |        |  |
| Cryomodules<br>Produced | 8            | 8      | 1                                | 1      | 1  |
|                         |              |        |                                  |        |  |

**Major Accomplishments**

- Assembly of the M-8 cryomodule has been completed on schedule.

**Key Issues & Actions Being Taken**

- Repair of the M-7 cryomodule vacuum leak is progressing well and is expect to be completed next week.
- Actual production in the previous 4 weeks (see table above) has fallen behind the plan because of consecutive high-pressure rinse pump failures. Resolution of pump lifetime problems is our top priority. Additional information has been obtained on failure modes through operation of the instrumented life extension test stand. Several factors (alignment, cooling and input restrictions leading to cavitation) have been identified as potential contributors to pump failure and all are addressed in the new installation.

We expect to resume cavity qualification next week and in preparation for this we are preparing cavities and hardware for processing. After satisfactory experience in cavity qualification we will reschedule M-10 string assembly.

**Management Items**

- Management continues to closely monitor progress on resolution of the high-pressure rinse pump problems.
- The follow-up close-out to the October 15, 2003 review of JLab's SNS cavity processing procedures and facilities will take place by videoconference February 2, 2004.
- The problem of end can instrumentation leaks has been exacerbated by the financial failure of the company from which they were purchased. This means that we will have to continue to test and repair units in house, rather than returning them to the vendor for repair.

**ASD/BNL: Ring**

Work continues with ASD to close the gap between cost risk contingency and budget for FY04 and 05.

Testing of a BCM in A10 house of the AGS is underway.

The Momentum Collimator Assembly is being crated at BNL for shipment to SNS/OR.

Ranor has finished work on the outer shield assembly for the Ring 2 and 3 collimators. The shielding is being prepared for shipment to SNS/OR. ETA is 2/9/04.



We shipped half-cell #19 to SNS/OR this week along with the half-cell lifting fixture. ETA has been delayed by a few days (next Monday) due to inclement weather. In the meantime, work continues on the assembly of HC units #20 and 21.

Vendor bids for the extraction Lambertson magnet have been opened and are being evaluated.

Talks are being prepared for the Diagnostics Advisory Committee meeting that is to be held at BNL next week.

#### Power Supply status:

- All the 185A units (5 ea) were built and tested. They should ship to SNS/OR by Feb. 9<sup>th</sup>.
- All of the 390A units (16 ea) are built and awaiting test.
- All the 700A, 18V units (13 ea) are built and fitted with a larger DCCT.
- The injection bump unit is awaiting the last few tests (PSI, interlock, heat run) before shipping.
- Work on the main dipole rectifier is about 95% complete.

#### Controls

FY04 PADS plans for the Controls Group were completed and approved by week's end.

Installation and testing of all control systems at high voltage (with the exception of the Matching Network) inside the Hot Spare Ion Source was completed this week. Some RF and noise problems remain, and they are being worked collaboratively by the Ion Source and Controls Groups. The Test Stand ran at 2 percent duty factor for 4 hours and 12 minutes using the control system.

As a result of the series of software standards meeting reported last week, work began on converting the code in each IOC in a series of three steps. First, code will be ported to EPICS v3.13.9, a baby step that removes a known bug in the version now running. Next, the EPICS "make" system, which compiles and loads the IOCs, will be converted to a new standard procedure. This step is complex, time consuming, and will present different problems for each IOC, because several different approaches are now in use. For that reason we are doing the IOCs serially, working with each IOC engineer one-on-one, and making the lessons learned available to the next. The first IOC – the MPS Master – took several days, but the pace is accelerating. The last step is to convert all IOCs from EPICS v3.13.9 to EPICS v3.14.4. This is a more significant change in the operating system, but all the groundwork is ready and tested and the process should be efficient once Step 2 is complete. A new IOC test plan has been generated as a part of this standardization initiative.

The Machine Protection System (MPS) Master Receiver board is out for a board layout quote. This board will replace 7 chassis in the MPS Master crate with one board for receiving the carrier clocks. Hardware is expected in approximately one month. A new transition module has been laid out to replace the MPS Test chassis as the carrier generator. This will remove several chassis per chain, resulting in a significant simplification of the MPS system. The new FPGA code which will reduce the number of button pushes required to reset a latched MPS trip has been

implemented and is under test. The MPS software (driver, database, and FPGA code) has been tested under EPICS versions R3.13.9 and R3.14.4. Verification will continue as the systems are converted to the new Source Mode and CCL Beam Stop mode.

64 utility modules have been successfully tested at BNL (with three requiring rework), and will be shipped to ORNL shortly. Purchasing department bottlenecks have finally broken, resulting in release of the order for the Yokogawa function generators, and the DAC modules used for the MPS trip level in the BLM system. The purchasing department is also now poised to release the order for the BLM digitizers, pending the outcome of next week's diagnostic review meeting.

Cable block diagrams and cable pull lists were completed for all of SCL vacuum controls, and the Ring Vacuum Controls test plan was updated. Ring Injection Dump software prepared by SvT was reviewed. Normal, warning, and abnormal conditions were defined and direction was provided to revise the software to meet the new Operating Screens requirements. This software should be finished in early March and will serve as a pilot for the new requirements. Following the successful precedent set for the DTL1 run, a "Scorecard" was developed that lists actions needed to support commissioning of DTL 1-3.

Following the December series of partner lab videoconferences to settle a number of vacuum control system issues, a new series was started this week to discuss magnet power supply controls. A new directory structure was set up for power supply applications and magnet data to conform to the overall restructuring taking place in all systems and to facilitate the ultimate use of the Oracle Database for this information.

DCS fabrication of the PLC and IOC racks for the High Beta cryomodules is complete. The 8 racks were inspected at DCS. All racks meet our requirements. (See photo below.)



## Installation

### Craft Snapshot 1/27/04

|                               |      |
|-------------------------------|------|
| ASD productive craft workers  | 54.0 |
| Foremen (Pd by 15% OH)        | 6.0  |
| AMSI management (Pd directly) | 3.0  |
| TOTAL AMSI WORKERS            | 63.0 |
| Less WBS 1.9, 1.2 etc         | 8.0  |
| Less absent                   | 2.0  |
| TOTAL PD BY ASD/ORNL DB WPs   | 44.0 |

## Operations Group

## **Accelerator Physics**

Good progress was made on the on-line models. We can now generate MAD files directly from the ring database. There are still a few problems to iron out, but this is nice milestone for us. The HEBT on-line modeling debugging effort also made nice progress, and we now get excellent agreement between MAD and the on-line model.

Work continues on the ring applications. Work started on the algorithm to control the HEBT arc achromat, and progress continues on the application to determine the position and angle of the beam injected into the ring.

Franz Gallmeier continues to make good progress on modeling the radiation from the ring injection dump. He is adding to the model detailed information on the injection chicane magnets and the injection dump magnets.

The power leads on all the installed HEBT magnets have now been correctly marked and verified. The database that details the polarity of the power supply connections has also been verified. We are now in a position to connect these magnets to their power cables, and this work will begin shortly.

## **Ion Source Group**

The efforts by the controls group, especially Alan Justice, allowed us to operate the hot spare stand for close to 30 hours with 20 Hz, 1 ms long, 40 mA pulses. Everything on the platform is now computer controlled and monitored, except for the heater supply that is on order, and the matching motor that is on the front end "as is", with parts no longer available.

Sparks, however, keep upsetting the control system and the RF amplifier. Using the new, invaluable capability of monitoring variables on the high voltage platform, it was found that the screen current indeed undergoes large excursions before the amplifier switches off. QEI has been consulted and efforts continue to eliminate those trips.

Efforts, lead by Johnny Tang, continue to computer control the vacuum system of the hot spare stand after the electrical group installed a required cable tray.

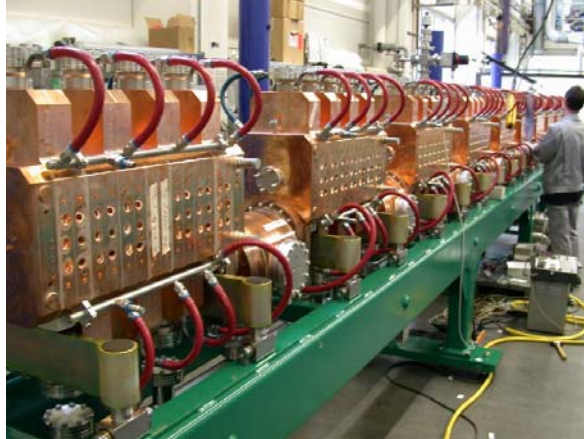
During FY'03 seven papers have been published by the ion source group, at least three of them have been peer reviewed. This count was done at the request of the division office.

## **Survey and Alignment Group**

### **Mechanical Group**

Orbital welding of the CCL-1 cooling tubes to the segments is complete. The joints look very good. Connecting the bellows between the module and the vacuum manifold is also complete. The priority for CCL-1 for the next two weeks is to complete as much of the vacuum and cooling system installation as possible.

The CCL-2 shipping date has been delayed one week (from Feb. 6 to Feb. 13) due to leaks in the joints between the bridge couplers and the segments. It seems likely that the problem is sealing surface preparation but this is not known for sure at this time. Repolishing the sealing surfaces began today (Jan. 30).



CCL-2 Module Leak Testing at ACCEL



CCL-2 Module (Right Side) and CCL-3 Support Stand (Left Side) at ACCEL

The braze repair of the CCL-3 end cell that had the blocked cooling channel is complete. The blocked section was machined out and a plug was made and brazed in place. Leak testing will be done next week.



CCL-3 End Cell Braze Repair

#### Ring Systems Installation

- The HEBT beamline from the SCL to the HEBT truck entrance (QV01-QH10) was pumped down to an ultra-high vacuum (UHV) level of  $1\text{E}-10$  Torr.

- Installation of the balance of corrector and klixon cables from the Ring Service building to HEBT was completed.
- Final flushing of the RING Systems' DI cooling loops by the installation contractor continued.

#### Water Systems Installation

- Installation of DI water piping on SCL ME-02 was completed.
- Installation of DI water piping on SCL ME-03 was started.
- Installation of DI water piping from the facility to the SCL ME-04 (SCL-TRCC7& TRCC\*) carts was started.
- Installation of DI water piping to all the CCL power supplies was completed.
- Preparation for installation of water manifolds on CCL module was started.
- Bar coding of all the water system components for maintenance database applications was started.

#### Magnet Task

This week we have measured three more CCL Quads.

We now have measured nine 21Q40's. We have two groups of three that are within 0.1%. We need two groups of four within 0.1%.

We have also continued aligning and checkout of the first 8Q35.

Also, CCL intersegment parts and fixtures have arrived from Los Alamos and we are starting to set up the assembly fixture. The vacuum group will test the beam tubes after which we will install them into magnets.

#### Electrical Group

All 4 DTL 1 EMDs have been connected to power supplies and tested. These magnets have been installed with incorrect thermal protection interlocks (150 F rather than 120 F) – the correct interlocks have been ordered by the Mechanical Engineering group and will be retrofitted as soon as they arrive (5-6 weeks). Controls group can now integrate the EMD power supplies into EPICS.

Problems with observed modulator oil congealing/polymer formation are due to oxidation, according to the oil manufacturer. This is only a problem when the modulator tanks are opened for service for an extended period (<2 weeks). Solutions are to clean tanks and remove polymer with mineral oil, and to put a nitrogen blanket over units opened for an extended period. These solutions will have little impact on operations and servicing.

The failure of IGBTs in SCL ME-1 observed a few weeks ago have been traced to improper application of heat sink compound by Dynapower when installing the IGBTs. All units installed so far and all IGBTs delivered have this problem, requiring disassembly of the IGBT heat sinks and the correct application of heat sink compound. This process will take about 1 week per modulator.

LANL has observed overheating and melting of modulator tank transformer spacers. We are implementing a better flow of oil to these components on existing and future modulator installations.

SCL ME-1 modulator has been reinstalled after inspection and repairs. We will complete checkout soon.

DTL ME-1 modulator IGBTs have been removed for upgrade with proper heat sinking (these IGBTs were prototypes with only 20Hz capability). We will also perform an inspection of the modulator tank and transformer next week and upgrade oil flow to the transformer.

Completed all Ring service Building DC magnet cabling to the tunnel. Started AC wiring in this building.



## **HPRF**

Two more 3-klystron HV tanks were installed, completing the ME2 klystron set of 12. The water cooling pipes were fitted to the klystrons and electrical cable pulls will begin next week. SCL HV tank preparation continues.

The output waveguide on the 5MW CCL-1 klystron was filled with SF6 under the direction of Karen Young from LANL. The CCL-1 klystron was brought up to full voltage (135kV) with a 20 Hz rep rate in the diode mode (no RF output). When RF operation began, arcs occurred. The RF signal source was found to have random spikes of high noise. This is being investigated. In addition, some waveguide bolts were found not to be at the full specified torque setting. Every bolt in the CCL system was checked and re-torqued. No significant levels of RF leakage were detected but new procedures are being implemented to be extra cautious. William Roybal from LANL will be at SNS next week for the first RF operation.

Craig Diebele gave a talk to the ASD technicians on the function and theory of CCL and DTL structures and their tuning.

## **LLRF**

The parts kit for production of the HPMs and FCMs was shipped to Suntron on Monday. Another shipment or two of late or back-ordered parts will be sent to Suntron next week. We have a target date of Feb. 13 for inspecting first articles at Suntron, with the first phase of production to be complete within two weeks thereafter.

We discovered noise problems on the 805 MHz FCM installed on CCL1 during the initiation of RF testing of the CCL1 klystron this week. There was a spike of RF power at the leading and trailing edges of the RF Gate signal; this problem has been solved via FPGA code modifications. Otherwise, there is noise that is coincident with VXI-buss traffic involving the FCM. We will solve this problem through filtering, shielding and timing of buss traffic.

Meanwhile we have installed a temporary LLRF system to support RF testing of the CCL1 klystron. This is the same system that was used on SCL 1-12 recently. It has been enhanced so that the High-Power Protection Module is fully functional and will protect against arcs and RF over-power.

Chip Piller will attend a week-long EPICS training course at ORNL next week.

We are scheduled for LLRF testing at JLab beginning Feb. 26.

An additional spare digital board for the first generation control chassis (MEBT) has been assembled at LBNL and will be delivered to ORNL following acceptance testing.

## **Cryosystem Group**

The purifier was cooled back down and is now cleaning gas storage tanks, 6, 7, &8.

During the installation of the cold compressors it was discovered that the instrument feedthrus on all 4 cold compressors leaked. Several of the problem feedthrus were removed and sent back to the vendor for examination. Also, a sample of the faulty feedthrus was removed and sent to JLAB for analyses. We have continued to install the cold compressors without the final seals. This will allow fabrication and instillation of the gas piping to the compressors.

Work continues on the orbital welding installation of the warm gas piping. The Primary line of the return transfer line is undergoing final pressure and leak certification.

We are ordering parts for the cold box "U" tubes that have been certified for construction. We are awaiting the final designs of some of the "U" tubes. Also, we are waiting for the final design drawings for the dummy cryomodule.

## **Beam Diagnostics**